Multimedia Systems
Lecture – 13

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Types of Video Signals

Composite Video

- Composite video is also called baseband video or RCA video. It is the analog waveform that conveys the image data in the conventional NTSC, PAL and SECAM television signal.
- Composite video contains both chrominance (color) and luminance (brightness) information, along with synchronization and blanking pulses, all together in a single signal.
- This was done to reduce bandwidth and achieve real-time transmission.
- However, in composite video, interference between the chrominance and luminance information is inevitable and tends to worsen when the signal is weak.
- This is why fluctuating colors, false colors, and intensity variations are seen when a distant NTSC television station sends signals that are weak and not properly captured at home with old-fashioned “rabbit ears,” or outdoor “aerial” antennae.

S-Video

- S-Video (*Super-Video*, sometimes referred to as *Y/C Video*) is a video signal transmission in which the luminance signal and the chrominance signal are transmitted separately to achieve superior picture clarity.
- The luminance signal (*Y*) carries brightness information, and the chrominance signal (*C*) carries color information.
- Here, the chrominance signal (*C*) is formed by combining the two chrominance signals *U* and V into one signal along with their respective synchronization data, so at display time, the *C* signal can be separated into *U* and *V* signals.
- Separating the *Y* and *C* channels and sending them separately reduces problems caused by interference between the luminance and chrominance signals and yields a superior visual quality.

Component Video

- Component video strives to go a step further than S-Video by keeping all three *Y, U, V* (or equivalent) components separate.
- Consequently, the bandwidth required to broadcast component video is more than the composite or S-Video and, correspondingly, so is the visual quality.
- The separation of these components prevents artifacts due to intersignal interference.

Connectors for typical analog display interfaces. From left to right:, Composite video, S-video, and Component video

Digital Video

The advantages of digital representation for video are many. It permits

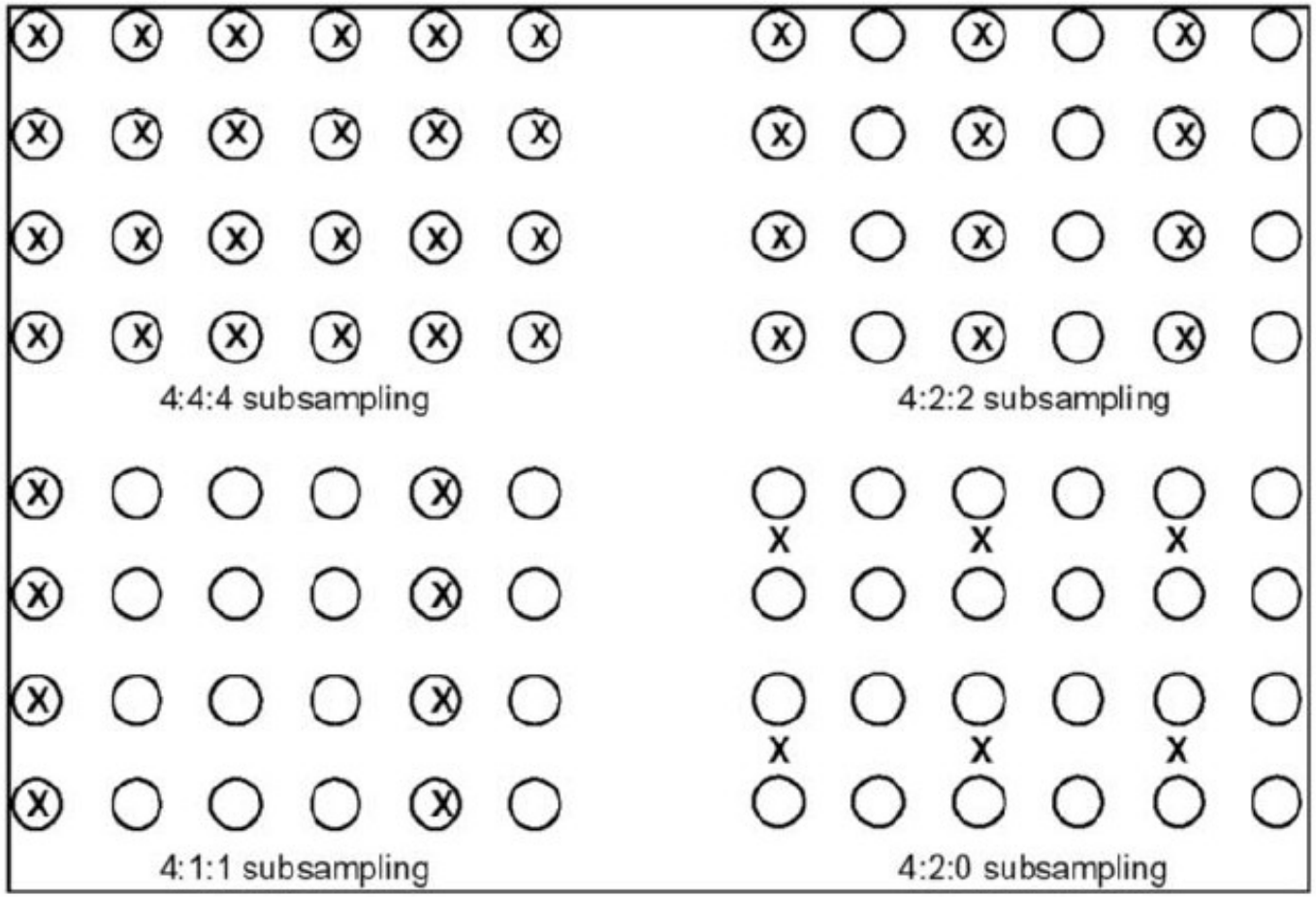
- Storing video on digital devices or in memory, ready to be processed (noise removal, cut and paste, and so on) and integrated into various multimedia applications.
- Direct access, which makes nonlinear video editing simple.
- Repeated recording without degradation of image quality.
- Ease of encryption and better tolerance to channel noise.

YUV Subsampling Schemes

- Video signals captured by digital cameras are represented in the RGB color space, which is also used to render video frames on a display device.
- However, for transmission and other intermediary processing, the YUV space is commonly used.
- The YUV space separates the color and luminance information.
- The color information (UV) is then further subsampled to gain more bandwidth.
- In analog video, subsampling is achieved by allocating half as much bandwidth to chrominance as to luminance.
- In digital video, subsampling can be done by reducing the number of bits used for the color channels on average.

- Depending on the way subsampling is done, a variety of subsampling ratios can be achieved.
- The circles represent pixel information.
- Potentially, we could store 1 byte each for Y, U, and V components, resulting in 24 bits per pixel.
- In subsampling, the luminance component Y is left untouched—that is, 1 byte is reserved for the luminance data per pixel.
- An X at a pixel position suggests that we also store the chrominance components for this position.

YUV subsampling schemes used in video



- In the 4:4:4 scheme, each pixel has luminance (8 bits) and chrominance (8 bits for U and 8 bits for V), resulting in 24 bits per pixel.
- In the 4:2:2 subsampling scheme, chrominance information is stored for every other pixel bringing the equivalent bits per pixel down to 16.
- In the 4:1:1 subsampling scheme, chrominance is stored every fourth pixel in a row.
- Whereas in the 4:2:0 scheme, the average of the U values for a 2×2 pixel area is stored, and similarly for the V values.
- Since there is only 1 U and 1 V sample for every four luminance samples, the equivalent bits per pixel is brought down to 12 bits per pixel.